CONDUCTIVE GASKET INCLUDING INTERNAL CONTACT-ENHANCING STRIP

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to conductive gaskets for shielding against electromagnetic interference (EMI gaskets), and more particularly, to a conductive gasket having improved performance when providing contact through non-conductive coatings.

2. Background Information

Conductive gaskets are widely used to prevent electromagnetic interference (EMI) leakage and entrance into and from electronic equipment. In particular, EMI gaskets are provided at the interfaces of computer cabinets and cabinets containing other electronic equipment so that radiated emissions fall below maximum radiated emissions requirements of various authorities such as the U.S. Federal Communications Commission (FCC) standards and Canadian Standards Association (CSA).

Typically, a wire mesh gasket including an internal foam material is provided on flanges and other interfaces of cabinets having exposed conductive surfaces. When the cabinet is closed, the gaskets are compressed providing a low-impedance contact between cabinet portions via the conductive wire mesh.

However, non-conductive coatings such as organic anti-fingerprint coatings are often used on equipment surfaces in order to provide improved appearance and to avoid oxidation initiated by contact with acids transferred from human skin. In

addition, such coatings prevent oxidation occurring naturally on exposed metal surfaces that do not have anti-corrosion platings. When a gasket, or the surface that a gasket is to contact is coated with such a material, the surface conductivity may be dramatically reduced, requiring removal of the coating before a sufficiently low-impedance contact may be made with the gasket.

Also, in general, as frequencies of electronic equipment (in particular digital computing systems) continue to increase, improved shielding is necessary, and therefore the performance of conductive gaskets becomes more critical.

Therefore, it would be desirable to provide a conductive gasket and method of manufacture for a conductive gasket having improved performance, and in particular a conductive gasket that will operate reliably when either the gasket or a mating surface is coated with a non-conductive coating.

SUMMARY OF THE INVENTION

The objective of providing improved conductive gasket performance, particularly in the presence of non-conductive coatings, is accomplished in a new conductive gasket and method of manufacture.

The gasket includes a contact strip provided beneath a flexible conductive cover. The cover may be a conductive wire mesh, or alternatively, a flexible plastic with a conductive coating on an exterior surface. The contact strip includes multiple protrusions that may pass through the cover when the gasket is compressed, providing improved contact with the surface that the protrusions contact and penetration of any non-conductive coating that is present. Holes may also be provided in a flexible plastic cover so that protrusions may pass through without damaging the cover.

Alternatively, the protrusions may be relatively smooth projections or bends in the contact strip that cause the flexible cover to bend sharply, providing corners in the cover that will break through any non-conductive coating that is present. The gasket may include a foam insert to restore the shape of the gasket when a compressive force is removed. A foam section may be included above the protrusions in order to preserve the shape of the gasket. Or, the gasket may be made entirely from a wire mesh with a contact strip woven inside. The contact strip may include protrusions on both faces so that contact is enhanced with two surfaces when the gasket is compressed.

The foregoing and other objectives, features, and advantages of the invention will be apparent from the following, more

particular, description of the preferred embodiment of the invention, as illustrated in the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself, however, as well as a preferred mode of use, further objectives, and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein like reference numerals indicate like components, and:

Figure 1A is a pictorial diagram depicting an open electronics cabinet including a gasket in accordance with an embodiment of the present invention.

Figure 1B is a pictorial diagram depicting further details of the cabinet and gasket of **Figure 1A.**

Figures 2A-2D are pictorial diagrams depicting cross-sectional views of gaskets in accordance with various embodiments of the present invention.

Figure 3A is a pictorial diagram depicting a side cross-sectional view of a gasket in accordance with another embodiment of the present invention.

Figure 3B is a pictorial diagram depicting a side cross-sectional view of a gasket in accordance with an alternative embodiment of the present invention.

Figures 4-6 are pictorial diagrams depicting cross-sectional views of gaskets in accordance with other embodiments of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The invention will now be described in more detail by way of example with reference to the embodiments shown in the accompanying figures. It should be kept in mind that the following described embodiments are only presented by way of example and should not be construed as limiting the inventive concept to any particular physical configuration.

Further, if used and unless otherwise stated, the terms "upper," "lower," "front," "back," "over," "under," and similar such terms are not to be construed as limiting the invention to a particular orientation. Instead, these terms are used only on a relative basis.

With reference now to the figures, and in particular with reference to **Figure 1A**, there is depicted an electronics cabinet **12** including an EMI gasket **10** in accordance with an embodiment of the present invention. Gasket **10** is installed on a flange **14** of cabinet **12** on which a cover (not shown) will be mounted. Gasket **10** provides a low-impedance connection between a cover and flange **14** so that electronics **16** is shielded from outside EMI and also reduces emissions from electronics **16** into the environment outside of cabinet **12**. While the installation of **Figure 1A** shows a typical use of an EMI gasket, gasket **10** is atypical, as gasket **10** includes improvements as will be detailed in the description below.

Figure 1B illustrates installation details of gasket **10**, including the contact of gasket **10** with a first surface **16A** of cover **16** as well as a second surface **14A** of flange **14** to which gasket **10** is attached via an adhesive or other mounting

mechanism. Contact of first surface **16A** with gasket **10** is a pressure contact that provides the electrical path from gasket **10** to cover **16** so that a highly conductive path is established through gasket **10** from cover **16** to flange **14**. Gasket **10** includes improvements detailed herein below, that aid in providing a highly conductive (low-impedance) path between two or more surfaces. In particular, if any of surfaces **14A** or **16A**, as well as the surfaces of gasket **10** are coated with a non-conductive coating, such as anti-fingerprint organic coatings or anti-oxidation coatings, gasket **10** includes features such that when gasket **10** is compressed, the coatings will be penetrated and a highly-conductive path established between the mating surfaces contacting the gasket.

In general, the surface to which gasket **10** is mounted will be conductive, and the surface of gasket **10** and the opposing surface to be contacted by gasket **10** will be coated and the surface of gasket may be coated as well. However, certain embodiments of gasket **10** that will be illustrated in detail below, are designed to penetrate non-conductive coatings at two or more surfaces of gasket **10** when gasket **10** is compressed.

Referring now to **Figure 2A**, details of gasket **10** are illustrated. Gasket **10** includes an outer conductive cover **26** in the form of a wire mesh, as is well known in the art of electromagnetic shielding gaskets. Within gasket **10**, a foam core **24** is introduced in order to shape wire mesh cover **26** into a D-shaped cross-section. Also within gasket **10** a conductive metal strip **20** including a plurality of protrusions **22** is located so that when gasket **10** is compressed, protrusions **22** protrude through cover **26**, penetrating any coating present on a surface that contacts the top surface of gasket **10**.

The bottom surface of gasket **10** is electrically coupled to the mounting surface **14A** by a conductive adhesive **28**, so that a conductive path is established between mounting surface **14A**, cover **26**, metal strip **20** and protrusions **22**. The combination of the electrically interconnected components listed above yield a very low-impedance path between surface **14A** and a surface placed in pressure contact with protrusions **22** and cover **26**. Alternative conduction mechanisms are possible and particular conduction mechanisms are illustrated herein below. Also, foam **24** may be a conductive foam, further reducing the impedance of the connection between metal strip **20** and surface **14A**. Protrusions **22** are generally of sufficient sharpness to provide for penetrations of surface coatings, but not so sharp as to pose an installation or handling hazard to persons handling or installing gasket **10**.

While most of the embodiments depicted herein are illustrated as having a D-shaped gasket cross-section, it will be understood that gaskets are supplied in a variety of shapes and sizes, and that the techniques of the present invention can be applied to other gasket shapes such as cylindrical, rectangular and hemispherical cross-sections.

Referring now to **Figure 2B**, details of a gasket **10A** in accordance with another embodiment of the present invention are illustrated. Gasket **10A** has a body formed from a wire mesh **26A**, as is well known in the art of electromagnetic shielding gaskets. Within gasket **10**, a conductive metal strip **20A** including a plurality of protrusions **22A** is located so that when gasket **10A** is compressed, protrusions **22** protrude through the top surface of wire mesh **26A**, penetrating any coating present on a surface that contacts the top surface of gasket **10A**.

The bottom surface of gasket **10A** is mechanically attached to mounting surface **14A** by an adhesive strip **28A**, but the conductive path that is established between mounting surface **14A**, wire mesh **26A**, metal strip **20A** and protrusions **22A** is provided by contact of wire mesh **26A**. The mounting arrangement shown, which is particularly suited to mounting via a double-sided adhesive strip that is non-conductive may also replace the illustrated mounting configurations depicted in the other illustrated embodiments and is shown here as an alternative mounting arrangement. The embodiment depicted in **Figure 2B** illustrates a conductive gasket in accordance with the present invention that does not require an internal foam insert, as the shape of gasket **10A** is maintained by solid wire mesh body **26A**.

Referring now to **Figure 2C**, details of a gasket **10B** in accordance with yet another embodiment of the present invention are illustrated. Gasket **10B** is similar to gasket **10** of **Figure 2A**, but is designed so that protrusions **22B** extend through cover **26B**, even when gasket **10B** is uncompressed. When gasket **10B** is compressed, protrusions **22** protrude further through the top surface of wire mesh **26B**, penetrating any coating present on a surface that contacts the top surface of gasket **10B**.

Referring now to **Figure 2D**, details of a gasket **10C** in accordance with still another embodiment of the present invention are illustrated. Gasket **10B** is similar to gasket **10** of **Figure 2A**, but cover **30** is a flexible plastic cover, which is generally a sputtered metal film. Perforations **32** may be pre-made in cover **30** and aligned with protrusions **22C** (or protrusions **22C** may self-align) so that cover **30** is not altered when gasket **10C** is compressed. Alternatively, in some applications such as for one-time installation, cover **30** may be made without perforations and

may be perforated by protrusions **22C** when gasket **10C** is compressed.

Referring now to **Figure 3A**, another gasket **10D** is illustrated. Gasket **10D** is similar to gasket **10B** of **Figure 2C**, but includes a foam section **24A** that preserves the shape of outer conductive cover **26** above contact strip **20B**, which is formed form a wire mesh. Within gasket **10D**, foam core **24** also holds the shape of outer conductive cover **26** to produce a D-shaped cross-section. All other features are as described above for gasket **10B**. Foam section **24A** may be conductive or non-conductive and may be of the same as or may be of a material differing from that of foam core **24**.

Referring now to **Figure 3B**, a cross-sectional view of a conductive gasket **10E** in accordance with an alternative embodiment of the invention is depicted. Gasket **10E** includes a strip **20C** that includes blunt protrusions **32** that do not penetrate gasket cover **26** when gasket **10E** is compressed. However, protrusions **32** cause the surface of cover **26** to bend sharply, when gasket **10E** is compressed, causing a break in any coating deposited on conductive cover **26**. Alternatively, bends or other shapes may be provided on contact strip **20C** as long as the bending requirement is satisfied. Strip **20C** is backed with a conductive or non-conductive foam **24** and is coupled electrically to surface **14A** by electrical contact with cover **26**, or via a conductive adhesive strip as described above. In the embodiment of **Figure 3B** strip **20C** does not have to be a metal conductive strip, but only have sufficient stiffness to cause sharp bending of gasket cover **26** surface when gasket **10E** is compressed.

Referring now to **Figure 4**, another gasket **10F** in accordance with an embodiment of the invention is shown. Gasket **10F** includes a metal contact strip **20D** having protrusions **22D** located on both a top and a bottom side. Providing protrusions **22D** on both sides of a gasket permits penetration of coatings on two gasket faces, or even penetration of an adhesive layer **28** when gasket **10F** is compressed. A wire mesh body **26C** is shown surrounding metal contact strip **20D**, but other forms of gaskets such as the foam and plastic cover embodiments described above may be adapted to include a double-sided contact strip such as metal contact strip **20D**.

Referring now to **Figure 5**, another gasket **10G** in accordance with an embodiment of the invention is shown. Gasket **10G** includes a metal contact strip **20E** having protrusions **22E** located on two faces beneath wire mesh body **26D** and a protrusion-less third bottom face (optional) for support. Without the bottom face, contact strip **20E** may be formed as a single strip and then bent at the apex. Gasket **10G** provides a conductive path between two or three surfaces for corners of cabinets.

Referring now to **Figure 6**, another gasket **10H** in accordance with another embodiment of the invention is shown. Gasket **10H** is a cylindrical gasket, as is often required for channel mounting. Gasket **10H** includes a metal contact strip **20F** in the form of a wire or rod **20F** having protrusions **22F** extending radially from the wire or rod **20F** and surrounded by a metal mesh **26E**. When gasket **10H** is compressed along a given radius, protrusions **22F** extending along that radius will penetrate mesh **26E** and provide improved conduction, penetrating any non-conductive coatings contacted by protrusions **22F**.

It should be understood, however, that the invention is not necessarily limited to the specific process, arrangement, materials and components shown and described above, but may be susceptible to numerous variations within the scope of the invention.

It will be apparent to one skilled in the art that the manner of making and using the claimed invention has been adequately disclosed in the above-written description of the preferred embodiments taken together with the drawings.

It will be understood that the above description of the preferred embodiments of the present invention are susceptible to various modifications, changes and adaptations, and the same are intended to be comprehended within the meaning and range of equivalents of the appended claims.